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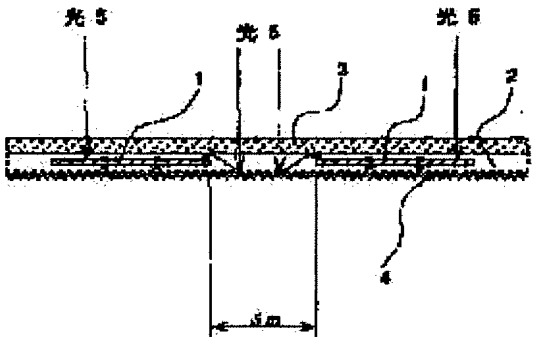
(54) SOLAR BATTERY MODULE

(57)Abstract:
PROBLEM TO BE SOLVED: To realize a structure wherein solar light photoelectric conversion efficiency is improved by increasing scattering reflection efficiency from a back cover member of a solar battery module, and weather resistance and moisture resistance are increased.
SOLUTION: This solar battery module 1 is provided with a plurality of solar battery cells 1 which are arranged in a plane type in such a manner that cell gaps are arranged mutually, a front cover member 3 composed of transparent material which is arranged in common on each light receiving surface side of the plural solar battery cells, and a back cover member 4 which is arranged in common on the back of the plural solar battery cells and contains reflecting material by which a light entering from the front via the cell gaps is scattered and reflected. The back cover member 4 is constituted of at least two layers formed of the reflecting material composed of resin material in which white based pigment is mixed and weather-resistant material composed of dielectric material. Inorganic oxide is added and inserted in a part between the layers, so that weather resistance and moisture resistance are increased.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1] Two or more photovoltaic cells which prepare a cel gap mutually and are arranged at a plane, The front-cover member which consists of the translucency ingredient arranged common to each light-receiving side side of two or more of these photovoltaic cells, It is the solar cell module which has the rear-face covering member arranged in common behind said two or more photovoltaic cells. Said rear-face covering member The solar cell module characterized by the thing of the resin ingredient layer in which the pigment was made to mix, and the weatherproof ingredient layer which consists of dielectric materials which it has two-layer at least and is further done for the addition insertion of the inorganic oxide among these layers.
[Claim 2] The resin ingredient layer in which said pigment was made to mix is a solar cell module according to claim 1 characterized by consisting of reflexibility material to which scatter reflection of the light by which incidence is carried out from the front through a cel gap is carried out.
[Claim 3] Said pigment is a solar cell module according to claim 1 characterized by being the white pigments containing a silica.
[Claim 4] Said inorganic oxide is a solar cell module according to claim 1 characterized by being SiOx.
[Claim 5] Said SiOx is a solar cell module according to claim 4 characterized by addition insertion being carried out by vacuum evaporationo.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is adopted as the solar energy power generation system for residences, and relates to a suitable solar cell module.
[0002]
[Description of the Prior Art] According to the classification system according to structure of the solar cell module specified by JIS C 8918, a solar cell module is classified into three kinds, a super straight type, a substrate type, and a restoration type, as a conventional example, but the solar cell module of the super straight type used present best is explained with reference to drawing 8 , drawing 9 , and drawing 10 here.
[0003] Drawing 8 is structural drawing of a typical super straight type solar cell module, and drawing 9 is drawing showing the cutting plane structure in the Ath page of drawing 8 . Moreover, drawing 10 is the partial expanded sectional view of the rear-face covering member 14 shown in drawing 9 . By interconnector 15, it has mutually two or more photovoltaic cells 11 by which wiring connection was made in a serial or juxtaposition electrically, the front-cover member 13 which changes from a translucency ingredient to the light-receiving side side of this photovoltaic cell 11 was placed, it considered as a modular supporting material, and said two or more photovoltaic cells 11 are enclosed with the bottom of it using the transparent packing material 12 and the rear-face covering member 14 so that clearly from this drawing.
[0004] As a front-cover member 13 of said translucency, glass is suitable, and white sheet tempered glass excellent in especially light transmittance and shock-resistant reinforcement is used well. PVB with little light transmittance lowering by ultraviolet rays as said transparent packing material 12 (Poly Vinyl Bu-tylol), EVA (Ethylene Vinyl Acetate) excellent in moisture resistance, etc. are mainly used. Moreover, as the partial enlarged section is shown in drawing 10 , weathering moisture resistance and electric insulation are given to the rear-face covering member 14 using the layer system which sandwiched the metal films 41, such as aluminum (aluminum), with the weatherproof resin films 42 and 43, such as PET (Polyethylenetelephthalate).
[0005] Furthermore, in order to give the reinforcement of the whole module, the outer frames 16, 17, 18, and 19 which consist of (Aluminum aluminum) extrusion mold material which is a lightweight metal are attached. In addition, 20 is a screw which is assembling these outer frames 16, 17, 18, and 19.
[0006]
[Problem(s) to be Solved by the Invention] By the way, although said conventional solar cell module arranges the photovoltaic cell 11 of small a large number like drawing 8 to said big translucency front-cover member 13 of one sheet and enlarges output power, in order that it may enlarge the amount of generations of electrical energy per module, the gap of two or more photovoltaic cells 11 arranged is made as narrow as possible, and usually carries out a large number loading mounting. However, by interconnector 15, as shown in drawing 9 , in order that two or more photovoltaic cells 11 by which wiring connection was made may carry out electric insulation of the adjoining photovoltaic cell 11 to electric especially a serial, or in order to arrange interconnector 15 to the front face of the following cel from the rear face of the cel which carries out a series connection, it was difficult to narrow by extent which can disregard a gap, and it usually needed the gap (about 2mm thru/or 5mm) with the conventional solar cell module mutually. The light which carries out incidence to this cel gap was not able to be contributed to a generation of electrical energy, and was not able to avoid decline in the photovoltaic cell generation efficiency per [resulting from this] module loading cel number of sheets.
[0007] In order to make the photovoltaic cell generation-of-electrical-energy degradation in this module loading ease, the solar cell module aiming at carrying out scatter reflection of the sunlight which carries out incidence to a gap, reflecting by the front-cover member 13 again, as are already indicated to JP,62-101247,U and these

people give dispersion reflexibility to the optical incidence, i.e., that front face, side of the rear-face covering member 14, and making a photovoltaic cell 11 reach has also been devised. However, as the adjoining gap between photovoltaic cell 11 described above, it was small or the effectiveness was hardly checked in a gap (about 2mm thru/or about 5mm).

[0008]

[Means for Solving the Problem] Two or more photovoltaic cells which the solar cell module of this invention prepares a cel gap mutually, and are arranged at a plane, The front-cover member which consists of the translucency ingredient arranged common to each light-receiving side side of two or more of these photovoltaic cells, It is the solar cell module which has the rear-face covering member arranged in common behind said two or more photovoltaic cells. Said rear-face covering member It has two-layer at least and is characterized by the thing of the resin ingredient layer in which the pigment was made to mix, and the weatherproof ingredient layer which consists of dielectric materials further done for the addition insertion of the inorganic oxide among these layers.

[0009] Moreover, you may make it the resin ingredient layer in which said pigment was made to mix consist of reflexibility material to which scatter reflection of the light by which incidence is carried out from the front through a cel gap is carried out. Said pigments may be the white pigments containing a silica. Said inorganic oxide may be SiOx. The addition insertion of said SiOx may be made to be carried out by vacuum evaporationo.

[0010]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing. Especially drawing 1 is drawing explaining the basal principle of this invention constituted as a super straight type solar cell module. The sunlight 5 which carried out incidence through the transparence packing material 2 which consists of the front-cover member 3, EVA, etc. which consist of translucency ingredients, such as glass While arriving at the light-receiving side of two or more photovoltaic cells 1 which form the predetermined gap Sm and are arranged to the plane and contributing to a generation of electrical energy It is reflected in this gap Sm by the reflexibility material which has also included the sunlight 5 which carried out incidence in the module rear-face covering member 4 and which improves especially dispersion reflexibility. It re-reflects and arrives at each light-receiving side of two or more of said photovoltaic cells 1, and each of two or more of these photovoltaic cells is more efficient, and enables it to transform into electrical energy the light energy by which incidence is carried out to each light-receiving side by said front-cover member 3 furthermore.

[0011] the super straight type solar cell module 6 of the simulation which prepared drawing 2 for the practicability check experiment of this invention -- it is -- this module -- the output measurement cel Q has been mostly arranged in the center section, the dummy cell D of eight sheets has been further arranged to the perimeter, and the optical generation-of-electrical-energy output of the output measurement cel Q was measured by making the gap Sm between each cel into a parameter. For example, the magnitude of the output measurement cel Q is the false angle cel of about 100mm**.

[0012] Drawing 3 graph-izes the relational data of the electric-generating-power rate of change Qm which the output measurement cel Q to the cel gap Sm by the above-mentioned experimental result increased. For example, the characteristic curve of the electric-generating-power rate of change Qm over the cel gap Sm is [the data of the cel gap Sm and the electric-generating-power rate of change Qm] exponential [the electric-generating-power rate of change Qm] according to a next door and this to the cel gap (2mm, 4mm, 8mm, 16mm, and 32mm) Sm 1%, 3.5%, 5.2%, 7.2%, and 8.8% respectively. if the value of the electric-generating-power rate of change Qm [%] itself is still small in the cel gap Sm being 5mm or less and a cel gap exceeds 30mm, the increment rate of an electric-generating-power rate-of-change Qm value will be alike, and it will become small, and will become a saturation inclination. Therefore, the cel gap Sm is large and its range of about 30mm is more practical than 5mm. In addition, since the experiment was conducted by the photovoltaic cell activity of 100mm**, it is meaningless to set up a cel gap more greatly than 100mm.

[0013] drawing 4 -- the characteristic curve of drawing 3 -- a logarithm -- it turns out that it graph-izes, and the following relational expression is materialized in the cel gap Sm [mm] and the electric-generating-power rate of change Qm [%] according to this.

Ln(Sm [mm]) =Ax(Qm [%]) +B -- here -- Ln -- a natural-logarithm function and Sm -- a cel gap and Qm -- electric-generating-power rate of change, and A and B -- a constant -- it comes out. The constant which becomes settled in the reflection factor of the reflexibility member by which the constant A was put on each photovoltaic cell rear-face side, distance with a front-cover member, etc., and the constant B were constants which become settled in area, photovoltaics conversion efficiency, etc. of one photovoltaic cell, and it was A= 0.364 and B= 0.215 in the above-mentioned experimental result. In addition, the reflection factor of the

reflexibility member put on each photovoltaic cell rear-face side in this case was about 70%, and the magnitude of one photovoltaic cell is 100mm**, and used the single crystal cel of 17% of that photovoltaics conversion efficiency.

[0014] In the above-mentioned example of an experiment of the solar cell module in the operation gestalt of this invention As the thing of said conventional example structure shown in drawing 10 [the] [same as a module rear-face covering member containing a reflexibility member] On the resin film 42 by the side of the top face of the aluminum material 41 of the main material made especially into the three-tiered structure, i.e., sunlight incidence [whether white pigments, such as a silica (SiO2), are made to mix, and dispersion reflexibility is given and] Or make said white pigments mix in the layer which makes vertical two-layer the packing materials 12, such as EVA shown in drawing 9 , and is filled up with the bottom, i.e., rear face of photovoltaic cell 11 (it sets to drawing 2 and they are output measurement cel Q and dummy cell D), side, and dispersion reflexibility is given (not shown). Although the reflection factor of that dispersion reflexibility member was made into about 70%, when raising this reflection factor with 80% and 90%, it turned out in another experiment that it contributes to the improvement in electric generating power further.

[0015] Drawing 5 is the rear-face covering member 7 which made the front face or whole to which light carries out incidence of the reflection factor of the dispersion reflexibility member contained in said rear-face covering member at least as structure raised further the concavo-convex configuration. And the concavo-convex configuration is considering as the shape of a chopping sea, the pyramid form, or the reverse pyramid configuration. The light 5 which has carried out incidence to it being such a configuration from a front face reflects multiply almost like travelling direction arrow-head 5a in the whole quantity, and it returns to a front face, and it can reflect by the front-cover member 3 again, a photovoltaic cell 1 can be reached, and it can contribute to the improvement in electric generating power. In addition, although not illustrated to drawing 5 , it cannot be overemphasized that there are packing materials 2, such as the transparent resin film 42 or transparent EVA, in the upper part of the aluminum material 41. Moreover, when it is made such a concavo-convex configuration, especially the front face of the aluminum material 41 may not perform delustering surface treatment which improves dispersion reflexibility, and a mirror plane (those with luster) is still sufficient as it.

[0016] By the way, since it is usually that said rear-face covering member 4 is thinly formed in the shape of film from the need of making that weight light in the case of a super straight type solar cell module, if this rear-face covering member 4 is used as the rear-face covering member 7 of a concavo-convex configuration like drawing 5 , it is possible [it] that it further becomes easy to expose the internal aluminum material 41, and the electric insulation failure accidents as a module come to occur frequently.

[0017] Then, especially in consideration of electric insulation, conductive metallic materials, such as aluminum material, are not used for said rear-face covering member 7. Said rear-face covering member 7 is constituted above two-layer at least as the resin film and the weatherproof resin film in which white pigments, such as a silica (SiO2), were made to mix instead. It is characterized [of this invention operation gestalt] also by replacing the film which has carried out addition insertion of the dielectric films, such as an inorganic oxide with a still more sufficient moisture-proof function (for example, SiOX), and a nitride (for example, SiNX), by approaches, such as vacuum evaporationo, between the layer as said rear-face covering member 7. If drawing 5 shows this, 41 will replace the resin film in which white pigments, such as a silica (SiO2), were made to mix, and will become the rear-face covering member 7 of the structure (not shown) which carried out addition insertion of the good dielectric film of said moisture-proof function by approaches, such as vacuum evaporationo, between the weatherproof resin films 43 of the rear face.

[0018] As mentioned above, although the gestalt of this invention operation has been explained with reference to drawing 1 thru/or drawing 5 , this is the ideal operation gestalt checked in the experiment, and if it is going to carry out this invention as it is, as the gap Sm between each photovoltaic cell is made large to about 30mm more greatly than 5mm so that drawing 2 may also show, the area as a module cannot but become larger. However, if unitization of several sets thru/or dozens of sets tends to be collectively carried out by making a solar cell module into the solar energy power generation system for residences etc. and it is going to install as a practical question, in many cases, a limit will be received in the installation area.

[0019] Then, the module shown in drawing 6 applied the operation gestalt of this invention to the module of the same dimension as the former, and, in the magnitude of a photovoltaic cell, the false angle cel of about 100mm** and photovoltaics conversion efficiency use about 17%. When the conventional module shown in the module and drawing 8 of this drawing is compared, by the module of drawing 8 , 54 6 train x nine-line = photovoltaic cells 11 are arranged, the space between trains of the gap between each cel is about 2mm, and the magnitude by the side of light-receiving of a solar cell module is 920mm [of about 614mmx abbreviation] = about 5648.8 cm2.

Moreover, in this invention operation gestalt application module of drawing 6 , the same photovoltaic cell as the thing of drawing 8 arranges 6 train x eight-line = 48 sheets, the about 2mm as usual with between [same / the mutual gap] trains and space are setting spacing of the cel of about 20mm and the circumference, and a frame to about 2mm, and the magnitude by the side of light-receiving of a solar cell module is 944mm [of about 614mmx abbreviation] = about 5796.2 cm2. In addition, although the partial expanded sectional view cut in the A-A' section of drawing 6 is shown in drawing 7 , the partial expanded sectional view cut in the B-B' section of drawing 6 is the same as that of the conventional example Fig. of drawing 9 .

[0020] In here, although there were few the parts and the photovoltaics electric-generating-power absolute values as a module than which six cel number of sheets of drawing 6 of this invention application module has become less, it was confirmed that the electric-generating-power rate of change Qm is improving about 4%. That is, it will have realized improvement in a relative output, this invention application module drawing 6 aiming at reduction of photovoltaic cell number of sheets from module drawing 8 conventionally. In addition, when the improvement in about 4% of this electric-generating-power rate of change Qm is converted into this invention basic form of drawing 2 , it is equivalent to that to which the space between trains set the gap Sm between photovoltaic cells to 5-6mm so that the property graph of drawing 3 may also show.

[0021] By the way, although the module output of this invention application module drawing 6 was 126W, supposing photovoltaic cell loading of 54 sheets is possible conventionally like a module noting that somewhat enlarging a module construction is allowed, the module output will be set also to 141.4W. However, by the conventional module of drawing 8 , in spite of having been 54 photovoltaic cell loading, the module output was 136W. In other words, the output per photovoltaic cell of this invention application module drawing 6 will improve from 2.52W of module drawing 8 to 2.62W conventionally.

[0022] If the solar energy power generation system for residences is built using this invention application module drawing 6 with the above properties, for example by this 24 module activity, the system output used as the total output is set to 126Wx24**3.02kW, and can respond to 3kW system of nominal outputs enough. However, with the view of the conventional module of drawing 8 , when the photovoltaic cell loading number of sheets was made into 48 sheets, the module output could take out only 121W, and the system output is 121Wx24**2.90kW, and was not able to respond to 3kW system of nominal outputs. (In the former, as a 54 photovoltaic cell loading module, it was made system output 136Wx24**3.26kW, and 3kW system of nominal outputs was supported.) Although in other words, as for drawing 6 of this invention application module, no less than six sheets save that photovoltaic cell loading number of sheets from 54 sheets from the conventional module of drawing 8 to 48 sheets, this economization effectiveness is very large. That is, the cost price (cost) of the photovoltaic cell to the manufacturing cost of current and a module is occupied 70 percent or more, and the cost cut effectiveness by economization of these six photovoltaic cells reaches also to x(-(54/48) 1)0.7=8.75%. This cost cut effectiveness aims at the spread of the solar energy power generation systems for residences upwards, and is a very important thing. In addition, if there are no still special technique and still special facility in purification of the high purity silicon required for manufacture of a photovoltaic cell, a semiconductor integrated circuit, etc., it cannot refine, but the solar cell module of this invention application will fully contribute also to solution of the shortage-of-money problem of a high-purity-silicon raw material. In addition, although the typical super straight type solar cell module explained that of this invention, it cannot be overemphasized that it is applicable also to a solar cell module other substrate types specified by JIS C 8918 and restoration type or the module of other types.

[0023]

[Effect of the Invention] Two or more photovoltaic cells which according to the solar cell module of this invention prepare a cel gap mutually and are arranged at a plane, The front-cover member which consists of the translucency ingredient arranged common to each light-receiving side side of two or more of these photovoltaic cells, It is the solar cell module which has the rear-face covering member arranged in common behind said two or more photovoltaic cells. Said rear-face covering member It has two-layer at least as the resin ingredient layer in which the pigment was made to mix, and the weatherproof ingredient layer which consists of dielectric materials. While being able to heighten dispersion and the reflection effect of the light which is characterized by furthermore carrying out addition insertion of the inorganic oxide among these layers, and carried out incidence to the solar cell module and being able to improve photovoltaics conversion efficiency, it can consider as the module structure excellent in dampproofing.

[0024] Moreover, the resin ingredient layer in which the pigment was made to mix can heighten a reflection effect by making it consist of reflexibility material to which scatter reflection of the light by which incidence is carried out from the front through a cel gap is carried out. A reflection effect can be heightened by using the

white pigments which contain a silica in a pigment especially.
[0025] Moreover, dampproofing can be raised by carrying out addition insertion especially by vacuum evaporationo by using SiOx for an inorganic oxide.
[0026] Moreover, dispersion and the reflection effect of the light which is characterized by the front face where light carries out incidence of said reflexibility material at least being a concavo-convex configuration, and carried out incidence to the solar cell module can be heightened, and photovoltaics conversion efficiency can be improved.
[0027] Moreover, the concavo-convex configuration of said reflexibility material can be characterized by being the shape of a chopping sea, a pyramid form, or a reverse pyramid form, can also use the total reflection effectiveness of light, can heighten dispersion and the reflection effect of the light which carried out incidence to the solar cell module, and can improve photovoltaics conversion efficiency.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing for explaining the basic principle of the solar cell module which consists of a gestalt of 1 operation of this invention.
[Drawing 2] It is the top view of the simulation solar cell module for a principle check of the solar cell module which consists of a gestalt of 1 operation of this invention.
[Drawing 3] It is the graph which shows the electric-generating-power rate of change Qm of the solar cell module which consists of a gestalt of 1 operation of this invention, and relation with the cel gap Sm.
[Drawing 4] the logarithm which shows the electric-generating-power rate of change Qm of the solar cell module which consists of a gestalt of 1 operation of this invention, and relation with the cel gap Sm -- it is a graph.
[Drawing 5] It is the expanded sectional view showing the configuration of the rear-face covering member containing the reflexibility member of this invention.
[Drawing 6] It is the top view of the solar cell module in one example gestalt of this invention.
[Drawing 7] It is the partial expanded sectional view cut in the A-A' section of drawing 6 .
[Drawing 8] It is the perspective view showing an example of the super straight type solar cell module of the conventional example.
[Drawing 9] It is the expanded sectional view showing the cutting plane structure in the Ath page of drawing 8 of the conventional example.
[Drawing 10] It is the expanded sectional view showing the detail of the rear-face covering member of the super straight type solar cell module of the conventional example.
[Description of Notations]
1 Photovoltaic Cell
2 Transparence Packing Material
3 Front-Cover Member (Translucency)
4 Rear-Face Covering Member
5 Incident Light
7 Rear-Face Covering Member with Concavo-convex Configuration
41 Metallicity Film or Weatherproof Resin Film Which Had Dispersion Reflex Function with Dielectric Film in Rear Face
42 Transparence or Weatherproof Resin Film with Dispersion Reflex Function
43 Weatherproof Resin Film

[Translation done.]

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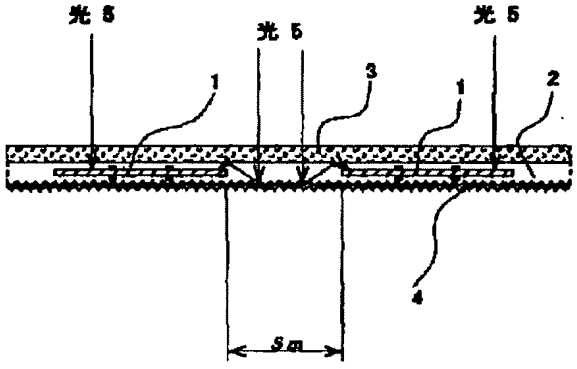
最終頁に続く

(54)【発明の名称】　太陽電池モジュール

(57)【要約】
【課題】太陽電池モジュールの裏面カバー部材からの散乱反射効果を高めて太陽光発電変換効率を向上するとともに耐候性、防湿性を高めた構造とする。
【解決手段】　相互にセル間隙を設けて平面状に配置される複数の太陽電池セル１と、該複数の太陽電池セルの各受光面側に共通に配置される透光性材料から成る前面カバー部材３と、前記複数の太陽電池セルの後方に共通に配置され、前記セル間隙を介して前方から入射される光を散乱反射させる反射性材を含む裏面カバー部材４とを有する太陽電池モジュール１であって、前記裏面カバー部材３は、白色系顔料を混入させた樹脂性材料から成る反射性材と誘電体材料から成る耐候性材料との少なくとも２層以上で構成され、これらの層間に無機酸化物を付加挿入することにより、耐候性、防湿性を高める。



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【特許請求の範囲】

【請求項１】　相互にセル間隙を設けて平面状に配置される複数の太陽電池セルと、該複数の太陽電池セルの各受光面側に共通に配置される透光性材料から成る前面カバー部材と、前記複数の太陽電池セルの後方に共通に配置される裏面カバー部材とを有する太陽電池モジュールであって、前記裏面カバー部材は、顔料を混入させた樹脂性材料層と誘電体材料から成る耐候性材料層との少なくとも２層を有し、さらにこれらの層間に無機酸化物が付加挿入されることを特徴とする太陽電池モジュール。

【請求項２】　前記顔料を混入させた樹脂性材料層は、セル間隙を介して前方から入射される光を散乱反射させる反射性材からなることを特徴とする請求項１に記載の太陽電池モジュール。

【請求項３】　前記顔料は、シリカを含む白色顔料であることを特徴とする請求項１に記載の太陽電池モジュール。

【請求項４】　前記無機酸化物はＳｉＯｘであることを特徴とする請求項１に記載の太陽電池モジュール。

【請求項５】　前記ＳｉＯｘは、蒸着により付加挿入されたことを特徴とする請求項４に記載の太陽電池モジュール。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、住宅用太陽光発電システムに採用して好適な太陽電池モジュールに関するものである。

【０００２】

【従来の技術】従来例として、例えばＪＩＳ Ｃ ８９１８で規定されている太陽電池モジュールの構造別分類体系によると、太陽電池モジュールはスーパーストレートタイプ，サブストレートタイプ及び充填タイプの３種類に分類されるが、ここでは、現在最もよく用いられているスーパーストレートタイプの太陽電池モジュールについて、図８、図９及び図１０を参照して説明する。

【０００３】図８は代表的なスーパーストレートタイプ太陽電池モジュールの構造図であり、図９は図８のＡ面での切断面構造を示す図である。また、図１０は図９に示す裏面カバー部材１４の部分拡大断面図である。該図から明らかなように、インターコネクタ１５によって互いに電気的に直列または並列に配線接続された複数の太陽電池セル１１を有し、該太陽電池セル１１の受光面側に透光性材料から成る前面カバー部材１３を置いてモジュールの支持材とし、その下に透明な充填材料１２と裏面カバー部材１４を用いて前記複数の太陽電池セル１１を封入している。

【０００４】前記透光性の前面カバー部材１３としてはガラスが適しており、特に光透過率や耐衝撃強度に優れている白板強化ガラスがよく用いられている。前記透明な充填材料１２としては紫外線による光透過率低下の少ないＰＶＢ（Poly Vinyl Bu-tylol）や、耐湿性に優れたＥＶＡ（Ethylene Vinyl Acetate）などが主に使用されている。また、裏面カバー部材１４には、図１０にその部分拡大断面を示すように、アルミニウム（Ａ１）などの金属フィルム４１をＰＥＴ（Polyethylenetelephthalate）などの耐候性樹脂フィルム４２，４３でサンドウィッチした層構造を用い、耐候耐湿性と電気絶縁性を持たせている。

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【０００５】さらに、モジュール全体の強度を持たせるため、軽量金属であるアルミニウム（Ａ１）押し出し型材などから成る外枠１６，１７，１８，１９を取り付けている。なお、２０は該外枠１６，１７，１８，１９を組み立てているネジである。

【０００６】

【発明が解決しようとする課題】ところで、前記従来の太陽電池モジュールは、１枚の大きな前記透光性前面カバー部材１３に、小さい多数の太陽電池セル１１を図８のように配列して出力電力を大きくしているが、モジュール１台当たりの発電量を大きくするため、配列される複数の太陽電池セル１１の間隙を可能な限り狭くして多数搭載実装するのが通例である。しかるに、図９に示すように、インターコネクタ１５によって互いに電気的に特に直列に配線接続された複数の太陽電池セル１１は、その隣接する太陽電池セル１１を電気絶縁するために、または、直列接続するセルの裏面から次のセルの表面へインターコネクタ１５を配置するために、間隙を無視できる程度までに狭くすることが難しく、従来の太陽電池モジュールでは通常約２ｍｍ乃至５ｍｍの間隙を必要としていた。このセル間隙に入射する光は発電に寄与せず、これに起因するモジュール搭載セル枚数当たりの太陽電池セル発電効率の低下を避けることができなかった。

【０００７】このモジュール搭載における太陽電池セル発電効率低下を少しでも緩和させるため、本出願人は、既に実開昭６２-１０１２４７号公報に開示しているように、裏面カバー部材１４の光入射側、すなわち、その表面側に散乱反射性を持たせるようにして、間隙に入射する太陽光を散乱反射させて再度前面カバー部材１３で反射して太陽電池セル１１に到達させることを目的とした太陽電池モジュールも、考案してきた。しかしながら、隣接する太陽電池セル１１相互の間隙が、前記したように僅か約２ｍｍ乃至５ｍｍ程度の間隙では、その効果がほとんど確認されていなかった。

【０００８】

【課題を解決するための手段】本発明の太陽電池モジュールは、相互にセル間隙を設けて平面状に配置される複数の太陽電池セルと、該複数の太陽電池セルの各受光面側に共通に配置される透光性材料から成る前面カバー部材と、前記複数の太陽電池セルの後方に共通に配置され

る裏面カバー部材とを有する太陽電池モジュールであって、前記裏面カバー部材は、顔料を混入させた樹脂性材料層と誘電体材料から成る耐候性材料層との少なくとも２層を有し、さらにこれらの層間に無機酸化物が付加挿入されることを特徴とするものである。

【０００９】また、前記顔料を混入させた樹脂性材料層は、セル間隙を介して前方から入射される光を散乱反射させる反射性材からなるようにしてもよい。前記顔料は、シリカを含む白色顔料であってもよい。前記無機酸化物はＳｉＯｘであってもよい。前記ＳｉＯｘは、蒸着により付加挿入されるようにしてもよい。

【００１０】

【発明の実施の形態】以下、本発明の実施の形態を図面を参照しながら説明する。図１は、特にスーパーストレートタイプ太陽電池モジュールとして構成した本発明の基本的原理を説明する図で、ガラスなどの透光性材料から成る前面カバー部材３及びＥＶＡなどから成る透明充填材料２を介して入射した太陽光５が、所定の間隙Ｓｍを設けて平面状に配置してある複数の太陽電池セル１の受光面に到達して発電に寄与するとともに、該間隙Ｓｍに入射した太陽光５も、モジュール裏面カバー部材４に含ませてある特に散乱反射性を良くする反射性材によって反射され、さらに前記前面カバー部材３によって再反射し、前記複数の太陽電池セル１の各受光面に到達して、該複数の太陽電池セルの各々が各受光面に入射される光エネルギーをより高効率で電気エネルギーに変換できるようにしている。

【００１１】図２は、本発明の実用性確認実験のために用意した模擬のスーパーストレートタイプ太陽電池モジュール６で、該モジュールのほぼ中央部に出力測定セルＱを配置し、さらにその周囲に８枚のダミーセルＤを配置し、各セル相互間の間隙Ｓｍをパラメーターとして出力測定セルＱの光発電出力を測定した。例えば、出力測定セルＱの大きさは約１００ｍｍ□の擬似角セルである。

【００１２】図３は、上記実験結果によるセル間隙Ｓｍに対する出力測定セルＱの増加した電気出力変化率Ｑｍの関係データをグラフ化したものである。例えば、セル間隙Ｓｍと電気出力変化率Ｑｍとのデータは、２ｍｍ、４ｍｍ、８ｍｍ、１６ｍｍ、３２ｍｍのセル間隙Ｓｍに対して、電気出力変化率Ｑｍはそれぞれ、１％、３．５％、５．２％、７．２％、８．８％、となり、これによると、セル間隙Ｓｍに対する電気出力変化率Ｑｍの特性曲線は指数関数的である。セル間隙Ｓｍが５ｍｍ以下であると電気出力変化率Ｑｍ［％］の値そのものがまだ小さく、セル間隙が３０ｍｍを越えると、電気出力変化率Ｑｍ値の増加割合がに小さくなり、飽和傾向となる。従って、セル間隙Ｓｍは、５ｍｍより大きく、３０ｍｍ程度の範囲が実用的である。なお、実験は１００ｍｍ□の太陽電池セル使用で行ったので、セル間隙を１００ｍｍより大きく設定することは無意味である。

【００１３】図４は、図３の特性曲線を対数グラフ化したものであり、これによると、セル間隙Ｓｍ［ｍｍ］と電気出力変化率Ｑｍ［％］とに次の関係式が成立することがわかる。

Ｌｎ（Ｓｍ［ｍｍ］）＝Ａ×（Ｑｍ［％］）＋Ｂ

ここに、Ｌｎは自然対数関数、Ｓｍはセル間隙、Ｑｍは電気出力変化率、Ａ及びＢは定数、である。定数Ａは、各太陽電池セル裏面側に置かれた反射性部材の反射率及び前面カバー部材との距離等で定まる定数、定数Ｂは、太陽電池セル１枚の面積とその太陽光発電変換効率等で定まる定数で、上記実験結果においては、Ａ＝０．３６４、Ｂ＝０．２１５であった。なお、この場合、各太陽電池セル裏面側に置かれた反射性部材の反射率は約７０％であり、太陽電池セル１枚の大きさは１００ｍｍ□で、その太陽光発電変換効率１７％の単結晶セルを使用した。

【００１４】本発明の実施形態における太陽電池モジュールの上記実験例では、反射性部材を含むモジュール裏面カバー部材として、図１０に示す前記従来例構造のものと同様の、特に３層構造としたその中心材のアルミニウム材４１の上面側すなわち太陽光入射側の樹脂フィルム４２に、シリカ（SiO_2）などの白色顔料を混入させて散乱反射性を持たせるか、または、図９に示すＥＶＡなどの充填材料１２を上下２層にしてその下側すなわち太陽電池セル１１（図２においては出力測定セルＱ及びダミーセルＤ）の裏面側を充填する層に前記白色顔料を混入させて散乱反射性を持たせ（図示せず）、その散乱反射性部材の反射率を約７０％としていたが、この反射率を８０％、９０％と高めれば、さらに電気出力向上に寄与することが別の実験でわかった。

【００１５】図５は、前記裏面カバー部材に含まれる散乱反射性部材の反射率をさらに高められる構造として、少なくとも光が入射するその表面または全体を凹凸形状にした裏面カバー部材７である。そして、その凹凸形状が三角波状またはピラミッド形または逆ピラミッド形状としている。このような形状であると、前面から入射してきた光５のほぼ全量が進行方向矢印５ａのように多重反射して前面に戻り、再度前面カバー部材３で反射して太陽電池セル１に到達し、その電気出力向上に寄与することができる。なお、図５には図示していないが、アルミニウム材４１の上部には透明な樹脂フィルム４２または透明なＥＶＡなどの充填材料２があるのは言うまでもない。また、このような凹凸形状にすると、アルミニウム材４１の表面は、特に散乱反射性を良くするつや消し表面加工を施さなくて鏡面（つや有り）のままでもよい。

【００１６】ところで、スーパーストレートタイプ太陽電池モジュールの場合、その重量を軽くする必要性から前記裏面カバー部材４は薄く膜状に形成されるのが通例

であるため、この裏面カバー部材４を図５のような凹凸形状の裏面カバー部材７にすると、内部のアルミニウム材４１がさらに露出しやすくなり、モジュールとしての電気絶縁破壊事故が多発するようになることが考えられる。

【００１７】そこで、電気絶縁性を特に考慮して、前記裏面カバー部材７にアルミニウム材などの導電性金属材料を使用せず、代わりにシリカ（SiO_2）などの白色顔料を混入させた樹脂フィルムと耐候性樹脂フィルムとの少なくとも２層以上で前記裏面カバー部材７を構成し、その層間に、さらに防湿機能の良い無機酸化物（例えばSiO_x）や窒化物（例えばSiN_x）などの誘電体膜を蒸着などの方法で付加挿入してある膜を、前記裏面カバー部材７として置き換えることも本発明実施形態の特徴としている。これを図５で示せば、４１がシリカ（SiO_2）などの白色顔料を混入させた樹脂フィルムに置き換わり、その裏面の耐候性樹脂フィルム４３との間に、前記防湿機能の良い誘電体膜を蒸着などの方法で付加挿入した構造（図示せず）の裏面カバー部材７となる。

【００１８】以上、本発明実施の形態を図１乃至図５を参照して説明してきたが、これは実験で確認した理想的な実施形態であり、本発明をそのまま実施しようとすると、図２からもわかるように、各太陽電池セル相互間の間隙Ｓｍを５ｍｍより大きく３０ｍｍ程度迄広くすればするほどモジュールとしての面積が大きくならざるを得ない。しかし、実際問題として、太陽電池モジュールを住宅用太陽光発電システムなどとして数台乃至数十台をまとめてユニット化して設置しようとすると、多くの場合、その設置面積に制限を受けてしまう。

【００１９】そこで、従来と同一寸法のモジュールに本発明の実施形態を適用したのが、図６に示すモジュールであり、太陽電池セルの大きさは約１００ｍｍ□の擬似角セル、太陽光発電変換効率は１７％程度、を用いている。この図のモジュールと図８に示す従来のモジュールとを比較してみると、図８のモジュールでは、太陽電池セル１１が６列×９行＝５４枚配置せられ、各セル相互間の間隙は列間行間共約２ｍｍであり、太陽電池モジュールの受光側の大きさは、約６１４ｍｍ×約９２０ｍｍ＝約５６４８．８ｃｍ²である。また、図６の本発明実施形態適用モジュールでは、図８のものと同じ太陽電池セルが６列×８行＝４８枚配置しており、その相互間の間隙は列間が従来と同様の約２ｍｍ、行間が約２０ｍｍ、周辺のセルと枠との間隔を約２ｍｍとしており、太陽電池モジュールの受光側の大きさは、約６１４ｍｍ×約９４４ｍｍ＝約５７９６．２ｃｍ²である。なお、図６のA-A’部で切断した部分拡大断面図を図７に示すが、図６のB-B’部で切断した部分拡大断面図は図９の従来例図と同様である。

【００２０】ここにおいて、本発明適用モジュールの図６は、セル枚数が６枚少なくなっている分、モジュールとしての太陽光発電電気出力絶対値は少ないけれども、その電気出力変化率Ｑｍは約４％向上していることが確かめられた。すなわち、本発明適用モジュール図６は、従来モジュール図８より太陽電池セル枚数の低減を図りつつ、相対的出力の向上を実現していることになる。なお、この電気出力変化率Ｑｍの約４％向上は、図２の本発明基本形に換算すると、図３の特性グラフからもわかるように、太陽電池セル相互間の間隙Ｓｍを列間行間共５～６ｍｍにしたものに相当する。

【００２１】ところで、本発明適用モジュール図６のモジュール出力は１２６Ｗであったが、モジュール寸法を少し大きくすることが許されるとして、従来モジュールと同様に５４枚の太陽電池セル搭載が可能であるとすると、そのモジュール出力は１４１．４Ｗにもなる。しかし、図８の従来モジュールでは、太陽電池セル５４枚搭載であるにもかかわらず、そのモジュール出力は１３６Ｗであった。言い換えると、本発明適用モジュール図６の太陽電池セル１枚当たりの出力は、従来モジュール図８の２．５２Ｗから、２．６２Ｗに向上していることになる。

【００２２】以上のような特性のある本発明適用モジュール図６を利用して住宅用太陽光発電システムを構築すると、例えば本モジュール２４枚使用では、その合計出力となるシステム出力は１２６Ｗ×２４≒３．０２ｋＷとなり、公称出力３ｋＷシステムに十分対応できる。しかるに、図８の従来モジュールの考え方のままで、その太陽電池セル搭載枚数を４８枚にすると、モジュール出力は１２１Ｗしか取り出せず、そのシステム出力は１２１Ｗ×２４≒２．９０ｋＷで、公称出力３ｋＷシステムには対応できなかった。（従来では、太陽電池セル５４枚搭載モジュールとして、システム出力１３６Ｗ×２４≒３．２６ｋＷにして、公称出力３ｋＷシステムに対応していた。）言い換えると、本発明適用モジュールの図６は、図８の従来モジュールよりその太陽電池セル搭載枚数を５４枚から４８枚に、６枚も節約しているが、この節約効果は極めて大きい。すなわち、現在、モジュールの製造原価に対する太陽電池セルの原価（コスト）は７割以上も占めており、該太陽電池セル６枚の節約によるそのコストダウン効果は、（（５４／４８）-１）×０．７＝８．７５％にも達する。このコストダウン効果は、住宅用太陽光発電システムの普及を図る上において、極めて重要なことである。なお、太陽電池セルや半導体集積回路などの製造に必要な高純度シリコンの精製には、今なお特殊な技術や設備がないと精製できず、本発明適用の太陽電池モジュールは、高純度シリコン原材料の逼迫問題の解決にも十分に貢献することになる。なお、本発明のを、代表的なスーパーストレートタイプ太陽電池モジュールで説明したが、ＪＩＳ Ｃ ８９１８で規定されている他のサブストレートタイプ及び充填タイプの太陽電池モジュール、または、その他のタイプのモ

ジュールにも適用できるのは言うまでもない。

【００２３】

【発明の効果】本発明の太陽電池モジュールによれば、相互にセル間隙を設けて平面状に配置される複数の太陽電池セルと、該複数の太陽電池セルの各受光面側に共通に配置される透光性材料から成る前面カバー部材と、前記複数の太陽電池セルの後方に共通に配置される裏面カバー部材とを有する太陽電池モジュールであって、前記裏面カバー部材は、顔料を混入させた樹脂性材料層と誘電体材料から成る耐候性材料層との少なくとも２層を有し、さらにこれらの層間に無機酸化物が付加挿入されることを特徴とするものであり、太陽電池モジュールに入射した光の散乱・反射効果を高めることができ、太陽光発電変換効率を向上することができるとともに、防湿性に優れたモジュール構造とすることができる。

【００２４】また、顔料を混入させた樹脂性材料層は、セル間隙を介して前方から入射される光を散乱反射させる反射性材からなるようにすることにより、反射効果を高めることができる。特に、顔料にシリカを含む白色顔料を用いることにより、反射効果を高めることができる。

【００２５】また、無機酸化物にＳｉＯｘを使用することにより、特に蒸着により付加挿入することにより、防湿性を高めることができる。

【００２６】また、前記反射性材を少なくとも光が入射するその表面が凹凸形状であることを特徴とするものであり、太陽電池モジュールに入射した光の散乱・反射効果を高めることができ、太陽光発電変換効率を向上することができる。

【００２７】また、前記反射性材の凹凸形状が三角波状またはピラミッド形もしくは逆ピラミッド形であることを特徴とするものであり、光の全反射効果も利用して、太陽電池モジュールに入射した光の散乱・反射効果を高めることができ、太陽光発電変換効率を向上することができる。

【図面の簡単な説明】

＊【図１】本発明の一実施の形態よりなる太陽電池モジュールの基本原理を説明するための図である。

【図２】本発明の一実施の形態よりなる太陽電池モジュールの原理確認用模擬太陽電池モジュールの平面図である。

【図３】本発明の一実施の形態よりなる太陽電池モジュールの電気出力変化率Ｑｍとセル間隙Ｓｍとの関係を示すグラフである。

【図４】本発明の一実施の形態よりなる太陽電池モジュールの電気出力変化率Ｑｍとセル間隙Ｓｍとの関係を示す対数グラフである。

【図５】本発明の反射性部材を含む裏面カバー部材の構成を示す拡大断面図である。

【図６】本発明の一実施例形態における太陽電池モジュールの平面図である。

【図７】図６のＡ-Ａ’部で切断した部分拡大断面図である。

【図８】従来例のスーパーストレートタイプ太陽電池モジュールの一例を示す斜視図である。

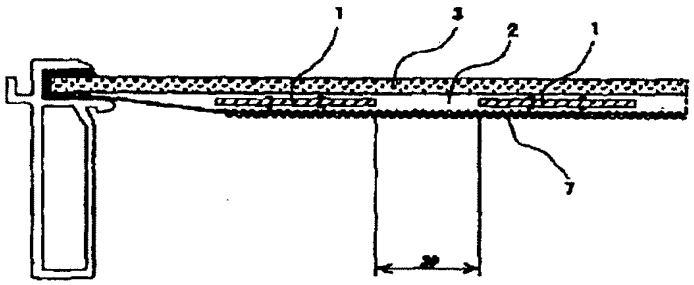
【図９】従来例の図８のＡ面での切断面構造を示す拡大断面図である。

【図１０】従来例のスーパーストレートタイプ太陽電池モジュールの裏面カバー部材の詳細を示す拡大断面図である。

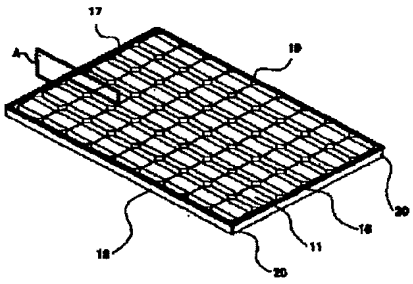
【符号の説明】

１　太陽電池セル
２　透明充填材料
３　前面カバー部材（透光性）
４　裏面カバー部材
５　入射光
７　凹凸形状のある裏面カバー部材
４１　金属性フィルム、または裏面に誘電体膜付の散乱反射機能を持った耐候性樹脂フィルム
４２　透明、または散乱反射機能を持った耐候性樹脂フィルム
４３　耐候性樹脂フィルム

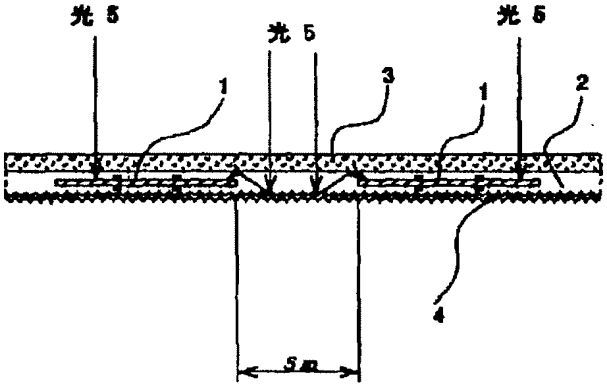
【図７】



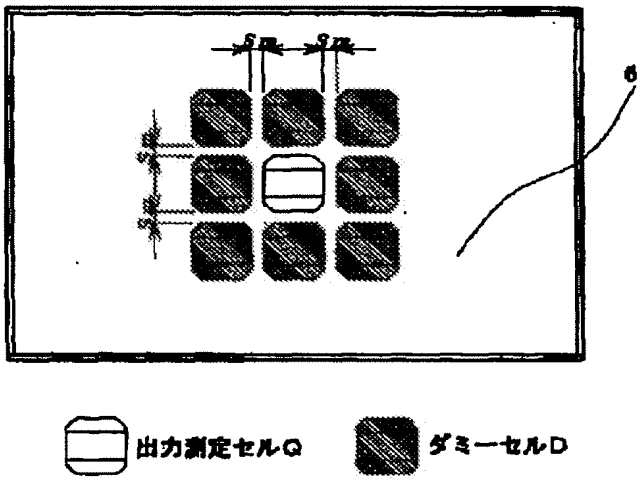
【図８】



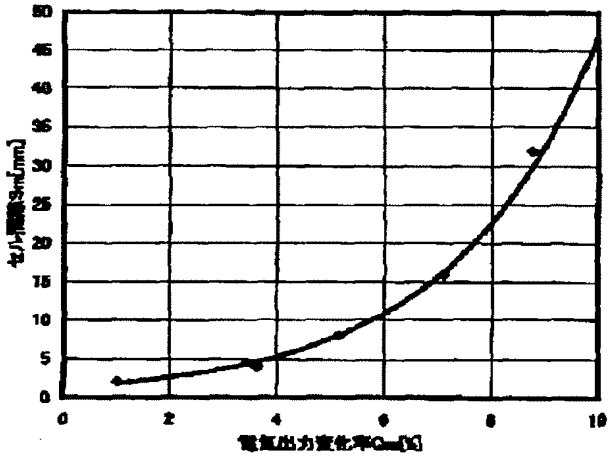
【図１】


光 5
光 5
光 5
1
3
1
2
4
Sm

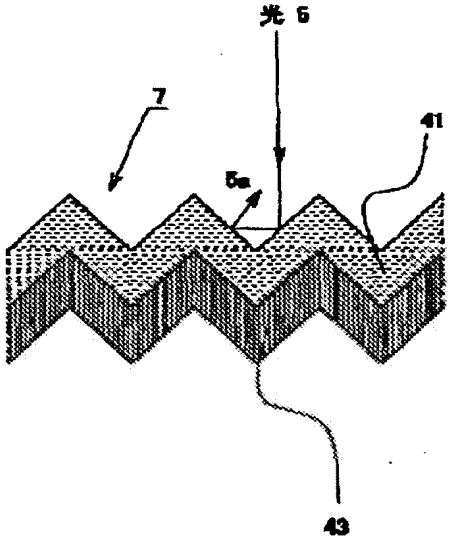
【図２】


Sm
Sm
6
出力測定セルQ
ダミーセルD

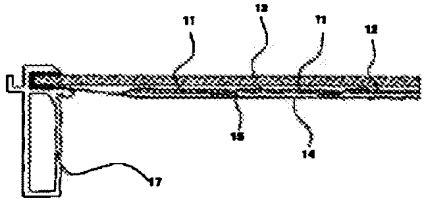
【図３】


0
5
10
15
20
25
30
35
40
45
50
0
2
4
6
8
10

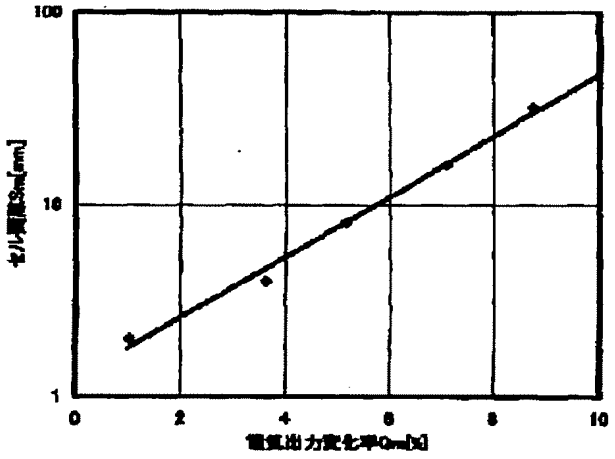
【図５】


光 5
7
41
5m
43

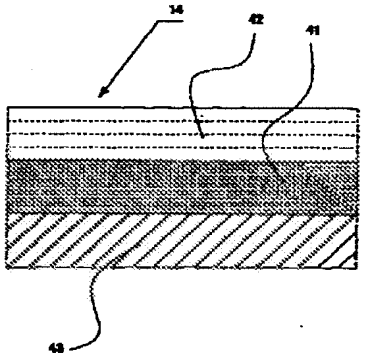
【図９】


11
13
11
12
15
14
17

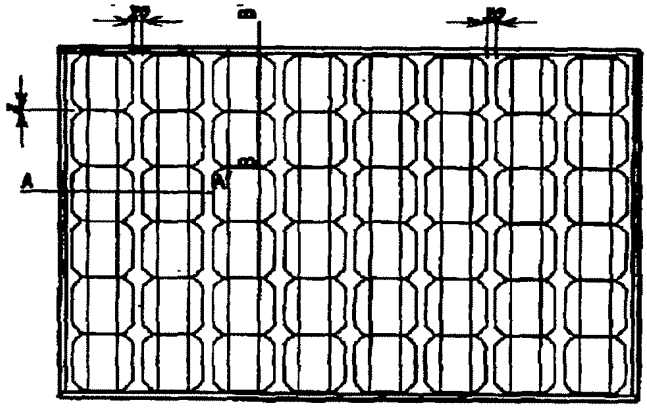
【図４】



【図１０】



【図６】



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